Ministry of
Transportation and
Communications

Ontario

MI-98

COMPUTERIZED AGGREGATE INFORMATION SYSTEM FIELD WORK TO CONTRACT SOURCES LIST

MATERIALS INFORMATION
ENGINEERING MATERIALS OFFICE

COMPUTERIZED AGGREGATE INFORMATION SYSTEM:

FIELD WORK TO CONTRACT SOURCES LIST

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MINISTRY OF TRANSPORTATION AND COMMUNICATIONS
ONTARIO

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SUMMARY

The Province of Ontario has a mature highway and municipal road network system of over 150,000 Km. Approximately 4 billion tonnes of aggregates were used in the construction and maintenance of this system over the last 40 years.

The use of these aggregates required an extensive field and laboratory testing program. The results of these investigations have been stored in a large manual filing system called the Mineral Aggregate Inventory. This information has been and is still being used for tendering on Ministry of Transportation and Communications contracts. The data is presented to contractors in a document call the Aggregate Sources List.

Decentralization of the preparation of Aggregate Sources Lists to the regional offices in 1977 made computerization of the Mineral Aggregate Inventory desirable.

On recommendation of an appointed task force, this work commenced during the summer of 1978. The task was broken up into three phases. Phase I consisted of placing source identification, name, location and other basic data into the computer. Phase II was designed to input and provide retrieval of data or quantity, suitability and operational constraints. Phase III was to make input and retrieval of material use information to and from the data base possible, and provide final enhancement of the full system. Phases I and II have been accomplished. Phase III is in the process of preparation. The data base (Mineral Aggregate Inventory Data Bank or MAIDB) is capable of producing pre-set reports, and provide information in "tailormade" fashion which can provide data for office and field work. It can also be used for the preparation of Aggregate Sources List.

The data bank consists of a "Master" file and "History" file which are available to Head Office and to the regional offices. The operation of the system was designed using Fortran language and IBM 303X and 308X series computers.

The total development cost of the system amounts to 430,000 (1985) dollars.

INTRODUCTION

During the post second World War years, a major highway and road building program started in Ontario, which was to meet the needs of the Province's expanding economy and increasing population growth. This construction activity which spanned the last 40 years resulted in the development of a mature highway and municipal road network, totalling 153,613 km.

The Province's current public highway system consists of 1,512 km controlled access multilane expressways, 14,323 km two lane asphalt surfaced highways, and 5,690 km secondary highways and access roads.

Similarly, the municipal road network has developed into 5,222 km multilane and 55,094 km two lane hard surfaced roads and 71,772 km gravel surfaced roads.

The major material requirements for this large network were sand, gravel and crushed rock. it is estimated that, during the past 40 years, approximately 4 billion tonnes of aggregates were used for this purpose.

It is indeed a fortunate fact of nature that the Province has been (and still is) well blessed with aggregate materials. The last ice age left a legacy of widespread deposits of good quality sand and gravel. In areas of local shortages of crushable gravel, good quality rock is available to fill the gap.

Due to the availability of local aggregates, haul distances of these materials to contracts was generally short (usually less than 10 km) resulting in a low cost of haulage. Consequently, the cost of highway construction was kept at a reasonable level during these expansion years.

AGGREGATE INVESTIGATIONS

We now know where the majority of aggregate deposits in the Province are situated. It took an extensive and ongoing pre-contract engineering field investigation program to locate them. An equally large laboratory testing program was required to ensure their suitability. As a general rule, these activities were, and in most cases are still being carried out for each major highway building contract (an average of 120 contracts/year), as illustrated in the flowchart, Figure 1. The various activities can be described as follows:

Office Preparation

Past history including previous field investigations, published data, record of previous uses on contracts are reviewed and assembled in a package for the field investigator on sources pertinent to the contract.

Field investigations

Field investigations are generally done in two parts. The first part is a preliminary investigation. This is to locate new deposits, using surface topographical observations, stereoscopic air photo interpretation, examination of surficial geology maps, publications and through personal contact with land owners.

Existing open pits or quarries in the vicinity of the proposed contract are also investigated visually for the quantity of remaining materials.

As the second part, power equipment investigation is carried out on selected sources (usually with a small back-hoe in soil or diamond drilling equipment in bedrock). Test pits are excavated in a pattern suitable to the deposit with spacing of 60-75 metres to a depth of four to five metres. The test pits are logged. Those containing acceptable materials are sampled.

A sketch plan is prepared showing test pit locations, open faces and landmarks, using a suitable scale. The contained quantity and suitability of the material are estimated, a source summary is written, and the samples are forwarded to the testing laboratory.

FLOW CHART OF AGGREGATE INVESTIGATIONS AND AGGREGATE SOURCES LIST PREPARATION

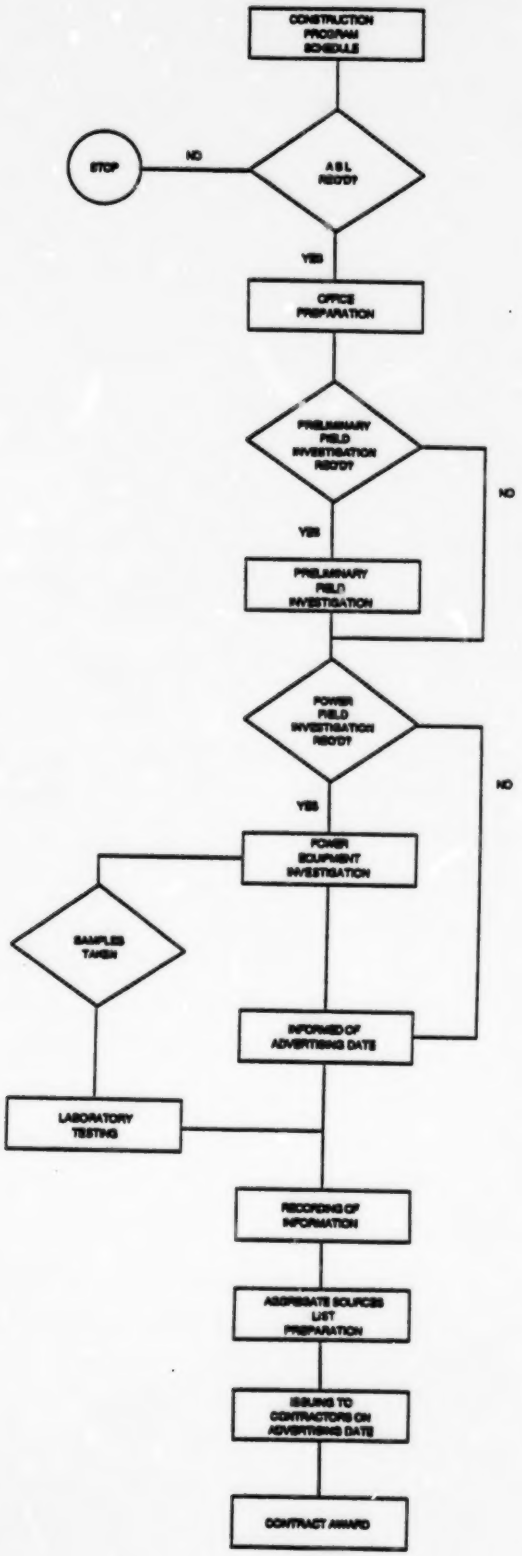

FIGURE 1

Laboratory Testing

The laboratory testing program for each sample consists of uncrushed sieve analysis and $MgSO_4$ soundness testing on both gravel and sand fractions. Petrographic analysis, determination of Los Angeles Abrasion loss, absorption and relative density are undertaken on the gravel fraction. In some cases, special tests, such as asphalt stripping, aggregate abrasion value, polished stone value, alkali-aggregate reactivity, and sand attrition may also be done. These tests ensure durability of the aggregates due to weathering and traffic loads, as well as desirable properties of surface texture of the pavements. Approximately 1,500 pre- contract engineering samples have been tested in MTC laboratories per year during the past four decades. This amounted to 60,000 individual sets of test results.

Mineral Aggregate Inventory

As field investigation data and laboratory test results were obtained, they have been recorded in a large manual filing system, called the Mineral Aggregate Inventory (M.A.I.). Since its inception in the early 1950's, it has accumulated field and laboratory data on 16,300 open pits and quarries, and potential deposits. 13,300 of these are located in an active file, and about 3,000 depleted or no longer useful sources are kept on inactive (dead) file. In the inventory, each aggregate source is identified by a dot on a topographical map, and has a unique inventory number which relates to the map on which it is located. Its location, past history, field investigation and published data are recorded on file cards. Field samples are cross referenced with a set of files containing laboratory test results. The source summary sketch and log of test holes are also kept in this file. The system occupies 70 filing drawers, which are divided into 50 drawers of active sources, 15 drawers of inactive sources and 5 drawers containing laboratory test results. In addition to this, there are three large vertical map files which contain topographical maps showing source locations within the Province. (See Figures 2 & 3).

The Mineral Aggregate Inventory also contains past suitability, quantity and operational constraints issued for previous contracts, as well as information on uses on individual contracts, such as tonnages removed, Hot Mix and concrete mix design, performance data and test results of production samples used on MTC contracts (Refer to Figure 4).

FIG. 2 - VIEW OF HEAD OFFICE MANUAL MINERAL AGGREGATE INVENTORY (TOPOGRAPHICAL MAPS ON THE LEFT. SOURCE SUMMARY FILES ON THE RIGHT).

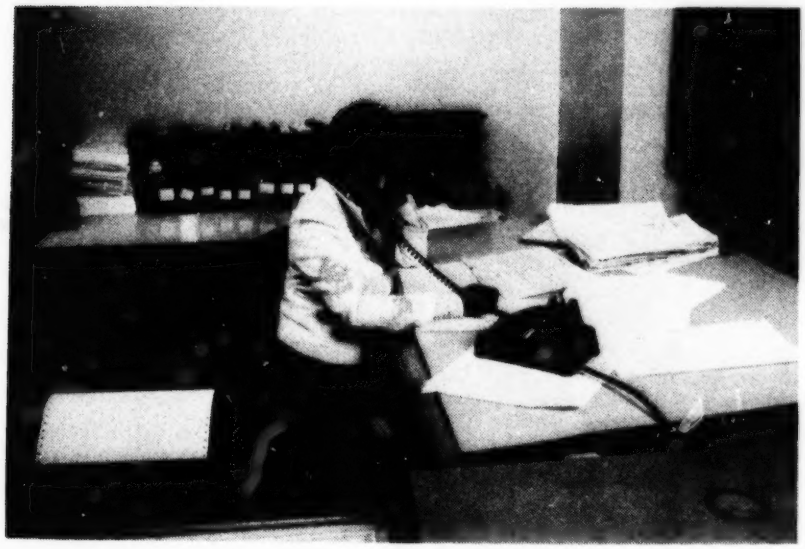

FIG. 3 - MAINTENANCE OF MANUAL MINERAL AGGREGATE INVENTORY BY CLERICAL ACTIVITY.

MINERAL AGGREGATE INVENTORY
SOURCES OF DATA

POWER EQUIPMENT INVESTIGATIONS	PRECONTRACT QUANTITY CHECKS	CONCRETE AND ASPHALT MIX DESIGNS	PHYSIOGRAPHICAL AND GEOLOGICAL MAPS AND REPORTS
PRELIMINARY FIELD INVESTIGATIONS	CONTRACT SAMPLES DURING CONSTRUCTION	M.N.R. QUARRY PERMITS LICENCES ETC.	PERFORMANCE OF MATERIAL AFTER CONSTRUCTION
TOPOGRAPHICAL MAPS	LABORATORY RESULTS	AVAILABILITY OF M.T.C. PITS	AIP PHOTO INTERPRETATIONS
POST CONTRACT QUANTITY ESTIMATES			GEOPHYSICAL EXPLORATIONS

FIGURE 4

The inventory is widely used to provide information to contractors and engineering consultants on municipal or private work as well as to give background data for reports, maps, and other publications issued by the Ministry of Natural Resources of Ontario and other provincial agencies (Refer to Figure 5).

Aggregate Sources List

For each major Ministry contract, a contract document, called the Aggregate Sources List (A.S.L.) is issued which shows locations of pertinent sources, their acceptability for the required aggregate uses, contained proven quantities, operational constraints, and other essential information to contractors for purposes such as clearance for operation from local municipalities. This document ensures fair competition between the tendering contractors, as well as between pit, quarry and potential deposit owners, ensuring equitable prices for aggregate items. The information shown on the Aggregate Sources List is guaranteed, removing any doubt on aggregate data necessary for tendering on these items. The contractor may, if he wishes, use other sources which are not shown on the Aggregate Sources List. However, in these situations the responsibility for acceptability, available quantity or operational constraints, rests with the contractor. Prior to January 1, 1986 this document was present in a manually prepared format (Refer to Figure 6).

Aggregate Sources List are prepared by Ministry personnel using past information obtained from the Mineral Aggregate Inventory as well as from recent field investigations and laboratory testing of samples. Clearances of sources for possible uses are obtained by communicating with townships where the aggregate sources are located and Ministry of Natural Resources and other Government agencies which may be involved.

Computerization of Mineral Aggregate
Inventory and the Aggregate Sources Lists

Until 1977, the storage and update of the Mineral Aggregate Inventory (M.A.I.) and the issuing of Aggregate Sources Lists (A.S.L.) was the responsibility of the Ministry's Head Office in Toronto.

In 1977, the Aggregate Sources List preparation was transferred to the Ministry's five regional offices located in London, Toronto, Kingston,

MINERAL AGGREGATE INVENTORY APPLICATIONS

COST ESTIMATES OF CONTRACTS	PUBLICATION OF AGGREGATE SOURCES LISTS	DEPARTMENTAL MAINTENANCE WORK
BASE COURSE AND PAVEMENT DESIGNS	QUALITY CONTROL DURING CONSTRUCTION	DETAIL INFORMATION FOR OPERATION OF PITS
SOILS DESIGN REPORTS	REPORTS TO CONTRACTORS ON CONTRACTS WITH NO AGGREGATE SOURCES LIST	ASSISTING OTHER PROVINCIAL AND FEDERAL DEPARTMENTS
PUBLIC RELATION	ASSISTING ARCHITECTS AND CONSULTING ENGINEERS	ASSISTING MUNCIPALITIES

FIGURE 5

CONTRACT No. 82-501 HIGHWAY No. 501 DISTRICT No. 7

FROM 4.8 KM WEST OF RNT. 505 WESTERLY FOR 3.4 KM.

TYPE OF WORK GRADING, DRAINAGE, GRANULAR BASE, DOUBLE SURFACE TREATMENT.

Ministry of Transportation and Communications — Ontario

AGGREGATE SOURCES LIST

GEOTECHNICAL SECTION

CENTRAL REGION

ABBREVIATIONS

mm = millimetres
SS = select subgrade material
SSA = subgrade strengthening granular aggregate
Gc = fine aggregate
Ga = coarse aggregate
SP = sand cover
PCC = Portland cement concrete

GRADE
A = acceptable
NA = not acceptable
U = not assessed
UC = unconsolidated sand deposit

No.	SOURCE NAME	OWNERSHIP	LOT	CON	SOURCE LOCATION	QUANTITIES (tonnes) TOTAL	NON-CRUSHABLE	CRUSHABLE	DEPTH OF CUT (m) MAX	AVG	% MATERIAL LARGER THAN 475 mm	75 mm	19 mm	POSSIBLE USES GRAN A	GRAN B	SSA	SSM	Double Surface Treatment PA	KA	Concrete PA	KA	REMARKS
1	Pit A Kilometre P6-12	Carson	3 4	VIII	3.2 km E. of Birchfield Lift Lock	25,000	25,000								I				M			P.E.I. 0.3 m to 0.6 m of stripping required. Material lacks crushable stone for crushed products. Sand grades fine and dirty for double surface treatment.
2	B. Collins P6-13A	Eldon	11 12	S.S. P.R.	Birchfield	Remarks			1.2 1.4	0.3 0.5	57 65	07 06	07 06		I		I		M	M		P.E.I. 0.1 m to 0.9 m of stripping required. Acceptable material located in scattered pockets, quantity unknown. Remainder of tested area contains very fine sand and silt. Sand control required for Granular M. Sand gradings vary from fine to dirty for double surface treatment.
3	Township of Eldon (Pickup) P6-21	Eldon	36	S.S. P.R.	1.5 km E.W. of Birchfield	Remarks																Not available for M.T.C. use.
4	E. Symmers P6-39	Eldon	44 45	S.S. P.R.	0.5 km E. Jct. Boys. 503 & 48	10,000	10,000								I		U		M	M		P.E.I. 0.5 m to 0.6 m of stripping required. Acceptable Granular M, Type I located in pit floor. Very fine sand and silt pockets to be avoided. Sand grades fine for double surface treatment. Licensed under Pits and Quarries Act.
5	Sand Enterprises P6-56	Carson	3	VIII	5.0 km E. of Birchfield	5,000		5,000							I		I		I	M		P.E.I. 0.1 m to 0.6 m of stripping required. Oversize to be removed or crushed for Granular B, Type I. Sand control required for Granular M. Sand grades dirty for double surface treatment. Coarse aggregate available for double surface treatment due to poor quality.
6	Tanner P6-66	Eldon	34	1	1.0 km E. of Victoria Road	135,000		135,000							I		I		I	M		P.E.I. 0.1 m to 0.3 m of stripping required. Sand control required in sections for Granular M. Fine and coarse aggregate unavailable for double surface treatment due to poor quality.

CONDITIONS OF INFORMATION

(THESE CONDITIONS APPLY TO SOURCES SHOWN ON ALL PAGES OF THIS LIST AS WELL AS ON ANY ADDENDA)

1. PURSUANT TO SUB-SECTION 102-2 OF FORM 100 THE AVAILABILITY OF THE AGGREGATE MATERIALS TO THE CONTRACTOR IS NOT GUARANTEED, EXCEPT IN THE CASE OF SOURCES WHICH ARE UNDER THE JURISDICTION OF THIS MINISTRY. THE INFORMATION IS GUARANTEED UP TO AND INCLUDING THE TENDER CLOSING DATE OF THIS CONTRACT.
2. FOR SOURCES WHICH HAVE BEEN TESTED WITH POWER EQUIPMENT, ADDITIONAL INFORMATION SUCH AS FIELD LOGS OF TEST PITS AND TEST HOLES, TEST RESULTS OF SAMPLES AND LIMITS OF THE TESTED AREA, IS AVAILABLE AND MAY BE REVIEWED AT THE APPROPRIATE REGIONAL GEOTECHNICAL SECTION. HOWEVER, BECAUSE OF THE NATURE AND LIMITATIONS OF THIS INFORMATION IT IS SUBJECT TO MISINTERPRETATION AND, THEREFORE, IS TO BE USED ONLY AS A GUIDE IN THE ASSESSMENT OF A SOURCE. ON THIS BASIS IT IS EXCLUDED FROM THE GUARANTEE INDICATED IN FORM 100 SUBSECTION 102-2.
3. CRUSHABLE MATERIAL SHALL BE DEFINED AS UNPROCESSED MATERIAL CONTAINING A MINIMUM OF 55% OF PARTICLES LARGER THAN 475 mm AND, AT THE SAME TIME, CONTAINING A MINIMUM OF 30% OF PARTICLES LARGER THAN 25.4 mm.
4. TO ACHIEVE ACCEPTABLE QUALITY OF THE AGGREGATE INVOLVED, CERTAIN PRODUCTION PROCESSES MAY BE NECESSARY. FAILURE BY THE CONTRACTOR TO ACHIEVE ACCEPTABLE QUALITY MAY LEAD TO REJECTION OR ACCEPTANCE AT LESS THAN THE CONTRACT PRICE.
5. EXACT CONDITIONS ASSIGNED FOR AN ACCEPTABLE WAYSIDE APPLICATION REGARDING: (I) DESIGNATED HAUL ROUTE, (II) DESIGNATED WORKING AREA, (III) OPERATIONAL CONSTRAINTS, ARE AVAILABLE IN WRITING AT THE APPROPRIATE REGIONAL GEOTECHNICAL SECTION.

DATE OF ISSUE MAY 13, 1985

FIGURE 6

North Bay, and Thunder Bay. At the same time, duplicates of the appropriate portions of the Mineral Aggregate Inventory covering each region were also transferred to these regional Offices. The original Mineral Aggregate Inventory was kept at the Ministry's Head Office to meet the requirements of our Head Office, as well as contractors and other provincial agencies. The updating of the regional inventories then become the regions' responsibility. Updating, of the Head Office inventory was done by using paper copies, forwarded by mail.

This duplication process created an environment where an automated data processing system for the storage, use and update of the Mineral Aggregate Inventory and the preparation of Aggregate Sources List could be considered for greater effectiveness. A task force was appointed in October 1977, to recommend a feasible computer system to inventory, and retrieve aggregate source information on a centralized basis.

The task force, after a thorough study of the system, made the following recommendations in April 1978:

- develop new standard input forms and instruction suitable for computerization of M.A.I.

- record new information on the standard form for input into computer.

- code and computerize basic data (inventory number, name, location, A.S.L. information) for use on line.

- code and computerize inventory card data on magnetic tape.

- head office to be responsible for developments of the system.

- each regional geotechnical section to maintain their regional inventory (i.e. transaction) file.

- system should be developed to take full advantage of their regional inventory file.

- system should be developed to take full advantage of computer terminals in regional offices.

The task force recommendations were accepted, and developed work commenced during the summer of 1978.

This was arranged in close co-operation between the Soils and Aggregates Section and the Computer Systems Branch in the following manner:

1. The Soils and Aggregates Section is to provide statement of needs and staging of the development.

2. The Computer Systems Branch is to provide the development of programs for each stage.

3. The Soils and Aggregates Section is to input data into the system during the development stage and test the programs for effectiveness.

4. The Computer Systems Branch is to provide technical expertise in modification and enhancement of the programs.

5. The Soils and Aggregates Section is to provide liaison with and training to the Regional Offices for implementation.

University students, especially engineering students from University of Waterloo co-operative program and high school students interested in career development were, and are still being utilized extensively for the development work.

The development work has been divided into three phases:

Phase I

- determination of the co-ordinates (eastings and northings) of each aggregate source in the Universal Transverse Mertcator (U.T.M.) grid from topographical maps.

- determination of the closest and second closest highway to each source and measure the distance to these highways.

- development of input sheet format for Phase I.

- coding, recording and inputting the "basic data" of each source: inventory number, name of owner, geographical location (i.e. lot, concession, township, county, general location related to a well defined geographical point on topographical map, such as highway junctions, small communities), U.T.M. co-ordinates, closest, and second closest highways, and distances to highways onto magnetic tape.

- development of the program for transfer from magnetic tape to magnetic disc.

- transferring "basic data" from tape to disc.

- correction of erroneous data.

Phase II

- development of input sheet format for Phase II data.

- development of program for input of quantity acceptability and operational constraints data either by "batch/data set" or interactive methods.

- development of program to provide continuity between Phase I and II.

- coding and inputting data issued on current Aggregate Sources Lists using input programs.

- development of programs for retrievel of Phase I and II data from any individual source or a group of sources using set standard formats or a highly flexible format, selectively, using "batch" or interactive methods.

- separate "Master" and "History" files to ensure security of confidential unpublished information.

- development of program to produce Aggregate Sources Lists as a contract document.

- development of input sheet format for pre-contract engineering information either from existing or new field investigations.

- input of pre-contract engineering data from current or existing pre-contract engineering field investigations.

- testing and enhancement of input and retrieval programs for best effectiveness.

- issuing of Instruction Manual for programmers and users describing the system.

- issuing of detailed Users Guidelines for use of input and retrieval programs.

- instruction and training of regional staff.

- obtaining mainframe 132 character width terminal and on-line printer for the Soils and Aggregates Section.

Phase III

- development of input sheet format to record pre-contract engineering field work, contract use information, such as quantities and types of aggregates removed from each source; also input bituminous paving and concrete mix design information related to aggregates.

- development of program to input this data.

- enhancement of data input using Focus program.

- coding and inputting data on contract use.

- development of retrieval programs for contract use information.

- testing and enhancement of programs for best effectiveness.

- modification of Instruction Manual and Users Guide to include Phase III.

- instruction and training regional personnel in use of programs.

Achievements to date

1. All aspects of Phase I and II have been accomplished. Programs have been tested and found to be fully functional.

2. Instructions have been issued to regional personnel in the form of:

   a) Instruction Manual.
   b) User's Guide to programs.
   c) Three formal seminars with hand-on demonstration and training.
   d) Visits to two regions upon request.
   e) On-going personal communication by telephone.

3. The Ministry (since January 1, 1986) has been issuing Aggregate Sources Lists our of the data bank, through a terminal, and the printer. (Refer to Figures 7 and 8). An example of these are shown in Figures 9 and 10.

4. The Ministry can also issue the following standardized reports on any individual or any groups of aggregate sources:

   a) Basic information (inventory number, name, location, distances to highways, pit or quarry, licenced/unlicenced,open/unopen).

   b) All information (basic, quantity and suitability and operational control data).

   c) Quantity and suitability for all uses and operational constraints.

   d) Quantity data.

   e) Suitability for granular base and sub-base.

   f) Suitability for hot laid bituminous paving coarse aggregate uses.

   g) Suitability for hot laid bituminous paving fine aggregate uses.

   h) Suitability for concrete coarse aggregate uses.

   i) Suitability for concrete fine aggregate uses.

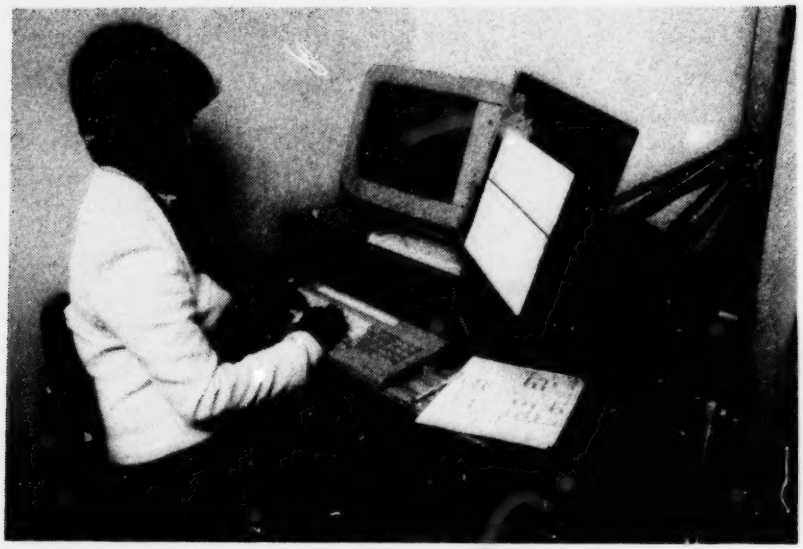

FIG. 7 - USING THE 132 CHARACTER WIDTH TERMINAL FOR INPUT AND RETRIEVAL OF ENGINEERING DATA AND PREPARATION ON AGGREGATE SOURCES LISTS.

FIG. 8 - THE ON-LINE PRINTER USED FOR PRINTOUTS OF REPORTS AND AGGREGATE SOURCE LISTS

MINISTRY OF TRANSPORTATION
AND COMMUNICATIONS, ONTARIO

AGGREGATE SOURCES LIST

GEOTECHNICAL SECTION

REGION : SOUTHWESTERN

DISTRICT NO. 3

CONTRACT NO. 86-05

HIGHWAY NO. : 10/24/89

LOCATION : 0.3 KM WEST OF SHELBURNE EAST LIMITS EASTERLY, 5.0 KM AND FROM SHELBURNE NORTH LIMITS NORTHERLY, 5.3 KM.

TYPE OF WORK : GRADING, DRAINAGE, GRANULAR BASE, PAVING AND RESURFACING

DATE OF ISSUE :86 07 14

ABBREVIATIONS

16 MM CR - 16 MM CRUSHED
S S M - SELECT SUBGRADE MATERIAL
S T C A - SURFACE TREATMENT COARSE AGGREGATE
FA - FINE AGGREGATE
SC - SAND COVER
OS - OVERSIZE
SA - SAND
SI - SILT
SCR - SCREENINGS
ASL - AGGREGATE SOURCES LIST

GRAN - GRANULAR
STRUCT - STRUCTURAL
SURF - SURFACE
CA - COARSE AGGREGATE
PEI - POWER EQUIPMENT INVESTIGATION
VCA - VIRGIN COARSE AGGREGATE
VFA - VIRGIN FINE AGGREGATE
CR - CRUSHABLE
CR"D - CRUSHED
MHD - MARSHALL MIX DESIGN

LIC - LICENCE
CMP - COMPACTION
DIF - DIFFICULT

SYMBOLS

X - ACCEPTABLE
N - NOT ACCEPTABLE
R - CONDITIONALLY ACCEPTABLE
I - REQUIRES INVESTIGATION

FIGURE 9

CONTRACT NO. 86-05

NOTE THAT THE INFORMATION IS "STACKED"; IE HEADING A CORRESPONDS TO LINES A, HEADING B CORRESPONDS TO LINES B, HEADING C TO LINES C

A	ASL MAP NO.	SOURCE NAME	TOWNSHIP	LOT NOS. FROM-TO	CONCESSION FROM-TO	SOURCE LOCATION	
B	INVENTORY NO.	LIC.	PIT/ QUARRY	OPEN/ UNOPEN	COUNTY, REG. MUN.	MAP [ZONE	EAST. NORTH.	TYPE OF INVESTIGATION
C		TOTAL QUANTITY (TONNES)	NON-CRUSHABLE (TONNES)	CRUSHABLE (TONNES)	DEPTH OF FACE (M) FROM-TO	DEPTH OF TEST HOLES (M) FROM-TO	STRIPPING REQUIRED (M) FROM-TO	% RETAINED 4.75 MM FROM-TO / 25.4 MM FROM-TO / 100 MM FROM-TO
A	7	C. FLEAR	MULMUR	- 1	SEE -RGHT	2.0 KM W OF VIOLET HILL (CON 2 EHS)	
B	D 4- 19- 0	YES	PIT	OPEN	DUFFERIN	17	571900 4883200	VISUAL
C		REMARKS :	:	:	-	-	-	- / - / -

SUITABILITY :

GRANULAR "A" I ----> X ---> SELECTION AND SAND CONTROL IS REQUIRED
GRANULAR "A" II ---> X ---> SELECTION AND SAND CONTROL IS REQUIRED
GRANULAR "B" I ----> X ---> OVERSIZE TO BE REMOVED OR CRUSHED
S.S.M. ------------> X ---> OVERSIZE TO BE REMOVED OR CRUSHED
H.L. 1 FA ---------> R ---> BLENDING REQUIRED IN ORDER TO PRODUCE AN ACCEPTABLE MARSHALL MIX DESIGN
H.L. 4 FA ---------> R ---> BLENDING REQUIRED IN ORDER TO PRODUCE AN ACCEPTABLE MARSHALL MIX DESIGN
H.L. 4 CA ---------> X ---> SEE REMARKS BELOW

REMARKS :

ALL TESTED MATERIAL HAS BEEN REMOVED. SOURCE HAS BEEN PARTIALLY REHABILITATED.
REQUIRES TESTING TO ESTABLISH QUANTITY OF REMAINING MATERIAL, IF ANY.
COARSE AGGREGATE IS ACCEPTABLE FOR HL-4 BASE COURSE ONLY.

A	8	DUFFERIN SA. & GR.	MULMUR	- 1	SEE -RGHT	3.0 KM E OF PRIMROSE (CON 2 EHS)	
B	D 4- 20- 0	YES	PIT	OPEN	DUFFERIN	17	572400 4883300	VISUAL
C		REMARKS :	:	:	-	-	-	- / - / -

SUITABILITY :

GRANULAR "A" I ----> X ---> SELECTION AND SAND CONTROL IS REQUIRED
GRANULAR "A" II ---> X ---> SELECTION AND SAND CONTROL IS REQUIRED
GRANULAR "B" I ----> X ---> OVERSIZE TO BE REMOVED OR CRUSHED
S.S.M. ------------> X ---> OVERSIZE TO BE REMOVED OR CRUSHED
H.L. 1 FA ---------> I
H.L. 4 FA ---------> I
H.L. 4 CA ---------> X ---> SEE REMARKS BELOW

REMARKS :

COMMERCIAL SOURCE.
COARSE AGGREGATE IS ACCEPTABLE FOR HL-4 BASE COURSE ONLY.

FIGURE 10

5. In addition to these reports, the users are able to retrieve data on any source or group of sources by using a flexible format which can be "tailormade" to meet the user's needs. Following are some of the main retrieval "keys" that may be used:
   - inventory number.
   - U.T.M. co-ordinates.
   - township code.
   - distance to highways.
   - suitability to specific uses.
   - licenced or unlicenced.
   - pit or quarry.
   - open or unopen.
   - contract or work project number.
   - or any combination of these.

To be accomplished

1. Phase III is currently in progress, and is expected to be completed by March 1987.

2. Additional training of regional staff is required to acquaint them with latest developments.

3. A feasibility study into the addition of laboratory test results to the system is to be completed.

4. Further enhancement of programs as required.

Brief description of the Computerized System

General

The inventory has been renamed Mineral Aggregate Inventory Data Bank (MAIDB). It has retained the main structure of the manual system. The aggregate sources are still plotted on topographical maps which are referenced to an electronic filing system through the computer terminal. The same type of information which has been kept on the card system is now recorded in an electronic filing system. The main advantages of the new system are:

- capability to select sources or desired information quickly from a large volume of data.

- elimination of duplication in recording data between Head Office and Regional inventories.

- reduction of clerical work due to direct input into the terminal.

- elimination of typing Aggregate Sources Lists since this can be obtained from a printer.

- less expansion of the manual filing system since recording is made on electronic file.

- increase in accuracy since recording and typing errors have been reduced and terminology has been standardized.

As described above, the computerized inventory will have beneficial effects on the field investigations, as well as the Aggregate Sources List preparation, providing easier handling of data (Refer to Figure 7).

The MATDB system is separated into two main parts. The "Master" file conrains all information published on Aggregate Sources Lists cumulatively; i.e. all quantity, suitability, and operational data are being added to previous data. This file is available to the public, municipalities, contractors, etc.

The "History" file is a ledger which records all information chronologically. The data in this file may contain unpublished data such as field information collected before the advertising of a contract. Therefore, this file is kept confidential, and can only be released selectively. The MATDB System structure can best be presented by its flow chart. (Refer to Figure 11).

Cost

The cost of the development of MATDB amounts to about 430,000 (1986) dollars. It is expected that an additional 24,000 dollars will be spent in further development and enhancement.

MAIDB SYSTEM FLOWCHART

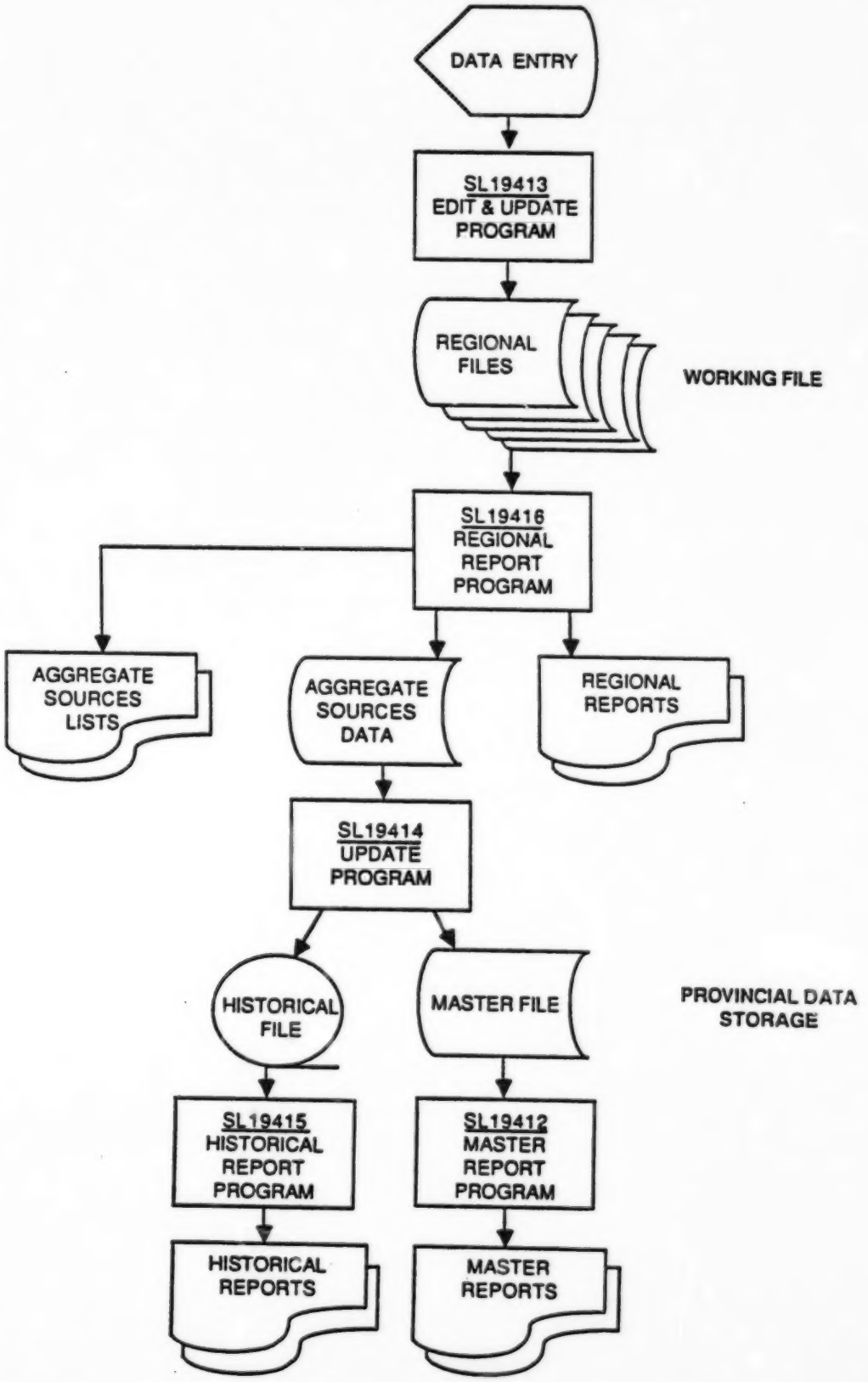

FIGURE 11

Computer Requirements

The MAIDB System has been created using the Fortran language and it is operated by four main programs designed by the Computer Systems Branch:

1. MAIDB03 - Regional input into "Transaction" files.

2. MAIDB04 - Update Head Office "Master" and "History" files from regional "Transaction" files.

3. MAIDB02 - Create standard and flexible format reports from "Master" file, including the Aggregate Sources List.

4. MAIDB05 - Create standard and flexible format reports from "History" file.

The details and use of these programs are described in the Instruction Manual and User's Guide, which are available in the Soils and Aggregate Section.

The use of the Fortran language necessitate laborious coding of a large amount of data by converting it to numbers. Modifications are under way to correct this by introducing a more user friendly "panel-driven" Focus input format. On the other hand, it provides a great deal of flexibility in the retrieval of the data, especially in the flexible format.

The System uses the computer disk memory of 14M bytes for the "Master" file. The "History" file is kept on one roll of magnetic tape with a density of 6250 B.P.I. (bytes per inch). To obtain information from this file requires mounting of the tape which results in a slight delay.

The running of the programs require a minimum of 820 K bytes of C.P.U. (Central Processing Unit) memory. The whole system operates using various IBM 303x and 308x series computers located at the MTC Head Office complex in Toronto.

Conclusions

The computerization of the Mineral Aggregate Inventory required a great deal of effort and technical expertise. Its use, however, makes storage and retrieval of aggregate material information more effective as compared to the manual filing system. With full development, it will increase the Ministry's capability to deal with aggregate related specifications and problems more efficiently.